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Salmon Smolt Transportation Experiments on the Conon River System, Ross-shire

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Salmon Smolt Transportation Experiments on the Conon River System, Ross-shire

INTRODUCTION

It has been the practice in many salmon management programmes to increase the spawning and nursery areas in a river system by making falls surmountable or planting other areas, not readily accessible to fish, with eggs and fry. There are instances where this practice, while producing more young salmon, will not result in an increased return of adult fish because of an unusually high smolt mortality. This may be due to one or more factors such as predation, delay or pollution. One remedy for this type of situation could be the collection and transportation of the smolts to an area downstream of the existing hazards and experiments to test the value of this remedy have been carried out on the River Bran, Ross-shire. This river forms part of the Conon River system which has been harnessed extensively for hydro-electric power.

The experiments started in 1963 and continued in 1964, 1965 and 1966. An account of the investigations on the River Bran which led to this experiment has been given by Mills (1964) and the preliminary results of the 1963 experiment have been described elsewhere (Mills, 1966). The results of the experiments in all four years, 1963 to 1966, are here given in detail.

METHODS

In the first two years, 1963 and 1964, smolts were caught in box traps, with wire netting leaders, which were placed in the River Bran above Loch Achanalt and the other hydro-electric reservoirs where the heavy loss of smolts was known to occur (Fig. 1). These traps were inoperable during flood conditions. Because of this and because of the encouraging results obtained from the first transport experiment, the North of Scotland Hydro-Board erected a Wolf trap, consisting of a horizontal wooden grid, collecting trough and holding box at the same site. This was used to catch migrants in 1965 and 1966. This trap was designed to fish at all river levels by being hinged to the river bed and the screens made buoyant with aircraft fuel tanks. The design was not entirely satisfactory and the trap was out of operation under some flood conditions.

A varying proportion of the smolts caught in each of the four years was tagged with numbered green or red plastic discs attached with darkened silver wire. Only a very small proportion of the fish was scaled or measured so as to reduce handling to a minimum. The smolts were transported a distance of twenty miles in a galvanized iron tank measuring $27'' \times 30'' \times 36''$ contained in a 15 cwt. trailer towed behind a Landrover. The tank was not provided with an additional supply of oxygen. The journey took approximately forty minutes and the largest number of fish transported at any one time was just over 500. The mortality on the journeys was minimal, for example, only 28 smolts died out of a total of 9090 transported in 1966. The water temperature was taken at the beginning and the end of each journey and there was generally little difference between the two readings. The water temperature during the period when the smolts were transported (April and May) ranged from 5·0 to 12·0°C. The fish were released at a point just below the confluence of the rivers Blackwater and Conon (Fig. 1).

Traps for ascending adults were present on all tributaries of the Conon system so that returning fish could be examined for the presence of tags.

RESULTS

(a) 1963

Because of floods the traps were only in full operation from April 22 to 30. Over this period, 899 smolts were caught and, of these, 649 were tagged, transported and released in the River Conon, and 240 were tagged and released downstream of the traps. The remaining 10 fish, which had been damaged in the traps, were released downstream untagged.

Only 19 (7·9%) of the fish released downstream of the trapping site on the Bran reached Luichart trap (Fig. 1) but no losses occurred during the downstream passage of the transported fish. None of the survivors of the group which had made their way downstream were recaptured as adults, but of those transported 18 (2·8%) were recaptured, 15 as one-sea-winter fish and 3 as two-sea-winter fish. Of these 18 recaptures, 15 were made either within the Conon River system (5 by rod and line, 6 in the Luichart trap and 1 in the trap at Loch na Croic) or in neighbouring coastal nets (2 at Cromarty netting station and 1 at Nairn netting station) and 2 were made on the west coast of Greenland. The precise position of recapture of the remaining fish is not known, as the tag was not detected until the fish was exposed for sale in the Aberdeen fish market. All but one of the recapture sites within the Conon River system lay upstream of the point of release and only two of these were not on the River Conon. These two were on the River Blackwater, another tributary of the Conon System (Fig. 1).

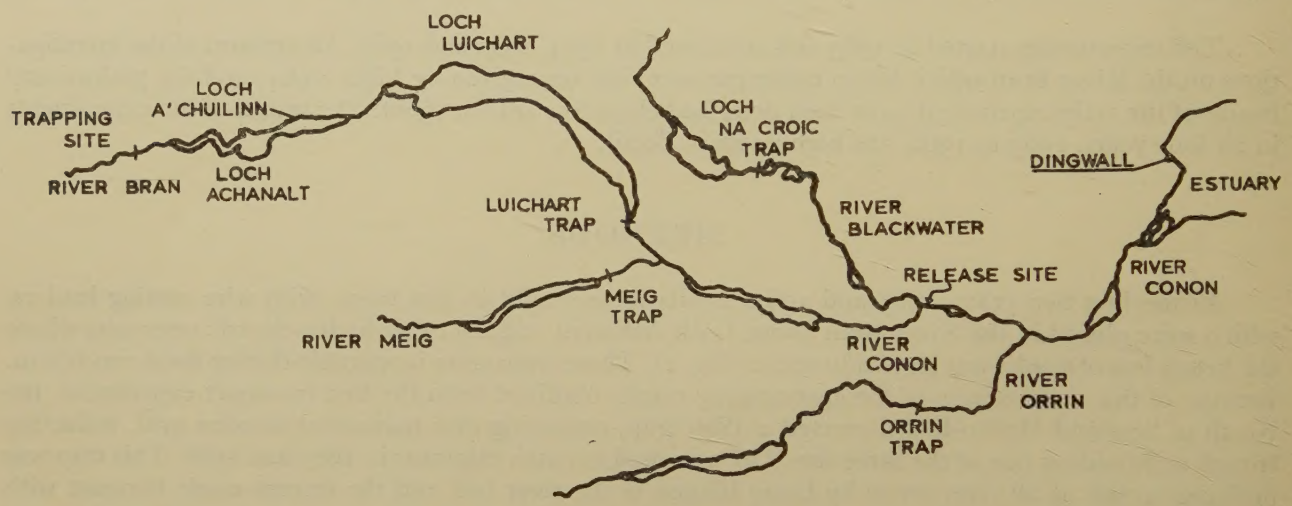

Fig. 1. Sketch map of Conon River system.

(b) 1964

Owing to unusually severe flood conditions the traps were only in operation for one day. This resulted in only 207 smolts being caught and transported, of which 180 were tagged. Four (2·2%) of the tagged smolts were recaptured as adults, 3 as one-sea-winter fish and 1 as a two-sea-winter fish. Two of the fish were recaptured off Greenland and two were caught on rod and line in the River Conon below the point of release.

(c) 1965

The modified grid-type trap was used in a half-finished condition and consequently, when the first flood occurred, the trap was put out of operation. In the five days the trap was operational 769 smolts were caught, 536 were transported and, of these, 534 were tagged. The remaining 233 smolts, all but two of which were tagged, were released downstream of the trap. Twelve (2·2%) of the transported smolts were recaptured as adult fish, 9 as one-sea-winter fish and 3 as two-sea-winter fish. The sites of recapture of these 12 fish were: Greenland—1; coastal netting station in the Moray Firth (Easter Delnies)—1; rod and line—5 (4 above the release point); Luichart trap—3; Meig Trap—1 and Loch na Croic trap—1.

Only one (0·4%) of the 231 tagged smolts released downstream of the trap was recaptured as an adult fish and this was caught at the Luichart trap.

(d) 1966

The grid-type trap was fully operational, with the exception of one 16-hour period, for 30 days from April 20 to May 21. Over this period 9235 smolts were caught and 9090 were transported for the loss of only 28 (0·3%). A little over one-third (3347) of the transported smolts were tagged. The number of tagged fish recaptured as adults totalled 134 (4·0%), 124 as one-sea-winter fish and 10 as two-sea-winter fish. The sites of recapture of these fish were: Greenland—14; coastal netting stations in the Moray Firth—4 (Hilton—3 and Easter Delnies—1); Conon Estuary—3; rod and line—29 (22 above the point of release); Luichart trap—45; Meig trap—16; Loch na Croic trap—7 and kelt nets set in Loch Achonachie (River Conon)—15[1].

Details of the numbers of fish transported and tagged each year, the number and percentage recaptured as adults and the sites of recapture are summarised in Table 1.

In 1963 and 1964 only numbered green plastic disc tags were used while in 1965 and 1966 green and red plastic discs were used. The results from the 1965 experiment showed that there was little difference in the percentage recapture of fish bearing either green (2·5%) or red (2·3%) tags, though the results from the 1966 experiment showed that the percentage recapture of fish carrying red tags (4·3%) was higher than that for fish with green tags (3·0%). This might be due to the fact that more fish were tagged with red tags and that they are more conspicuous to the angler, but there is some evidence to show that fish bearing green tags are taken by predators more frequently than those carrying red tags. This is suggested from an examination of nine red-breasted mergansers (*Mergus serrator*) shot on the lower reaches of the Conon. Although twice as many fish were released bearing red tags similar numbers of green and red tags (7 green and 9 red) were present in the birds' stomachs. This tends to indicate that fish bearing green tags were preyed on almost twice as heavily as those with red tags, although the numbers of green-tagged and red-tagged fish available to the predator are not known in detail. However, the numbers involved are so small that no worthwhile conclusions can be drawn.

TABLE 1

DETAILS OF TRANSPORTATION EXPERIMENTS, 1963-1966

Year	Number of Smolts		Number of tagged smolts recaptured as adults						
	Transported	Tagged	Greenland	Coastal waters	Estuary	Rod & Line	River Kelt nets	Traps	Total
1963	649	649	2	1	2	5	0	7	18[a](2·8)
1964	207	180	2	0	0	2	0	0	4 (2·2)
1965	536	534	1	1	0	5	0	5	12 (2·2)
1966	9090	3347	14	4	3	29	15	68	134[a](4·0)

[a]Including one recapture at an unknown site

DISCUSSION

The results from these four experiments have been most encouraging. The average percentage recapture of 2·8% is much higher than the values obtained from releases of larger batches of smolts in other parts of the Conon River system in earlier years (Pyefinch and Mills, 1963).

When the experiments were started, it was felt that one possible disadvantage of this operation would be that any fish returning might not migrate further upstream than the point at which they were released as smolts. The results show that this fear is unfounded as only 11 (8%) of the 136 tagged fish recaptured in the river above tidal limits were taken below the release site, and 39·7% of the 136 fish were recaptured in the Luichart trap. The recapture of tagged fish in traps on two of the three tributaries indicates that there was a certain amount of straying, although it was only appreciable in the neighbouring River Meig in 1966 (Table 2).

[1]The recapture site of the remaining fish is not certainly known. The tag was detected in a fishmonger's shop in Stockholm in 1970 but the fish may have been caught in Greenland in Autumn 1967 and kept in cold storage in the interval.

TABLE 2

NUMBER OF TAGGED SMOLTS RECAPTURED IN TRAPS AS ADULTS

Year	Luichart	Meig	Loch na Croic	Orrin
1963	6	0	1	0
1964	0	0	0	0
1965	3	1	1	0
1966	45	16	7	0

From these results it would therefore seem that transporting smolts past hazards on their downstream route to the sea appears to be of value in eliminating some of the disadvantageous effects of these hazards. However, before such a management project can be considered worthwhile the economics of the operation must be assessed.

ACKNOWLEDGEMENTS

We are most grateful to the North of Scotland Hydro-electric Board for the facilities they provided for this investigation. We also appreciate the kindness of the late Marques de Torrehermosa and Major Sir Reginald MacDonald-Buchanan for allowing us access to their land and agreeing to the erection of traps on their water.

SUMMARY

1. Over the period 1963 to 1966 a total of 10482 smolts was transported from the lower reaches of the River Bran, one of the tributaries of the Conon River system (Ross-shire) and released at a point below all the dams on this river system. Practically all (99·8%) the smolts survived the journey.

2. The percentages of smolts recaptured as adult fish from the 1963 to 1966 experiments were 2·8, 2·2, 2·2 and 4·0 respectively. 90% of the fish were recaptured within the Conon River system or in neighbouring coastal nets, whilst the remaining 10% were taken in Greenland waters.

3. The recapture of tagged fish in other tributaries of the river system indicated that there was a certain amount of straying, although it was only appreciable in the tributary nearest to the Bran.

4. These results suggest that transporting smolts past hazards on their downstream route to the sea appears to be of value.

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